Total Maximum Daily Load For Total Coliform Bacteria for Ocklawaha River Above Daisy Creek, Marion County, Florida

Florida Department of Environmental Protection
Watershed Assessment Section
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1.0 INTRODUCTION

1.1 Purpose of Report

This report presents a Total Maximum Daily Load (TMDL) for total coliforms for the Ocklawaha River above Daisy Creek. Using the methodology to identify and verify water quality impairments described in the Impaired Waters Rule (IWR), Chapter 62-303, Florida Administrative Code (FAC), the creek was verified as impaired for total coliforms, and was included on the verified list of impaired waters for the Ocklawaha River Basin that was adopted by Secretarial Order on August 26, 2002.

1.2 Identification of Waterbody

For assessment purposes, the watersheds within the Ocklawaha River Basin have been broken out into smaller watersheds, with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed. The Ocklawaha River above Daisy Creek has been assigned WBID 2740D (**Figure 1**).

The Ocklawaha Basin covers 2,769 square miles of the central to northern portion of Florida, encompassing parts of Alachua, Marion, Orange and Lake Counties. The Ocklawaha River is the largest tributary of the St. Johns River. USGS Hydrologic Unit Code (HUC) 03080102 defines the basin watershed.

The Ocklawaha Basin is composed of two hydrologically distinct parts. The Ocklawaha River and its associated lakes and tributaries occupy the eastern half and northern portions of the basin, comprising a defined, connected surface drainage system. Interstate 75 approximates the western boundary of the surface drainage system. Dominant features of the surface drainage system are large, connected lakes and wetlands.

The Ocklawaha River above Daisy Creek is located in the Marshall Swamp planning unit and is approximately 12 miles long. This segment of the river is essentially the beginning of the lotic (moving water) portion of the Ocklawaha River system. It begins at the Moss Bluff Lock and Dam and ends at its confluence with the Silver River. **Figure 1** illustrates WBID 2740D and its water quality monitoring stations.

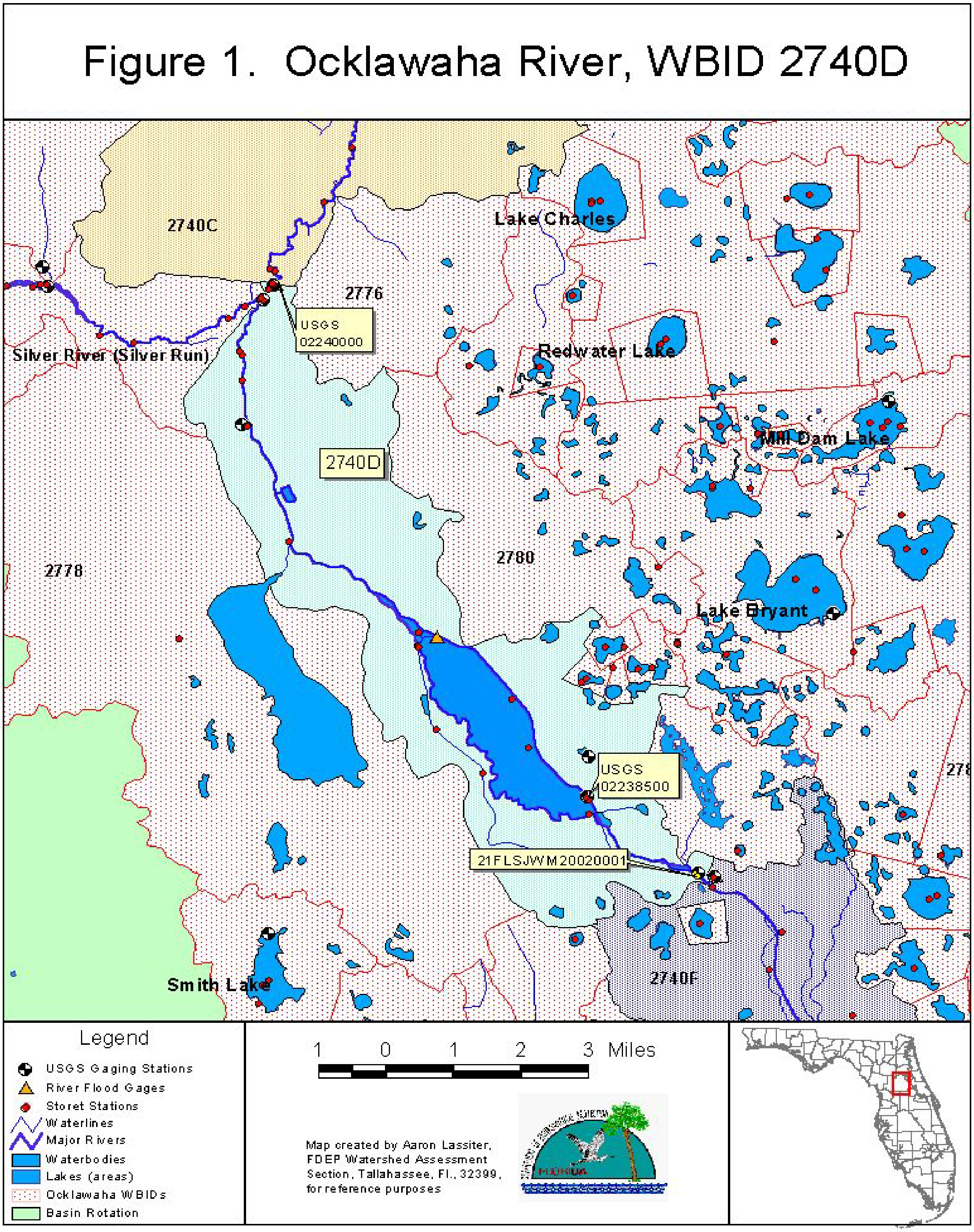


Figure 1. Ocklawaha River, WBID 2740D
2740C
2776
USGS 02240000
Lake Charles
Redwater Lake
Silver River (Silver Run)
Mill Dam Lake
2740D
2780
2778
Lake Bryant
USGS 02238500
21FLSJWM20020001
Smith Lake
2740F
Legend
USGS Gaging Stations
River Flood Gages
Storet Stations
Waterlines
Major Rivers
Waterbodies
Lakes (areas)
Ocklawaha WBIDs
Basin Rotation
1 0 1 2 3 Miles
Map created by Aaron Lassiter, FDEP Watershed Assessment Section, Tallahassee, Fl., 32399, for reference purposes

Historically, land cover in the basin was primarily agriculture (i.e., citrus farms) and navigation. Draining wetlands around upper basin lakes and Ocklawaha River to expose rich organic soils valuable for growing crops created muck farms in the basin. The muck farms were lower than their adjacent waterbodies, and required that water be pumped off the farmlands into those waterbodies.

For WBID 2740D, forest, wetlands, and agriculture dominate this segment of the river. This portion of the Ocklawaha River has received large sediment and pollutant loads over the years from muck farming and in the highly channelized Sunnyhill Farm area located immediately upstream. The St. Johns River Water Management District is now restoring Sunnyhill Farm. In addition to muck farming, this segment of the river receives pollutant loads from the more highly developed lakes located immediately upstream. The distribution of land cover for the Ocklawaha River above Daisy Creek is based on the National Land Cover Dataset (NLCD) of 1995 and is tabulated in **Table 1.**

Table 1. Land Cover Distribution[1]

Land Cover for Ocklawaha River above Daisy Creek	Total Acres	% Distribution
Urban	146.33	0.8
Transport., Commercial, Utilities, Public[2]	31.13	0.2
Agriculture	3,046.75	19.7
Barren Land	263.75	1.5
Rangeland[3]	656.93	3.8
Forest	8,803.19	51.0
Wetlands	3,805.71	22.0
Water	158.12	0.9
Total	17,271.91	100

1. Acreage represents the land use distribution in the impaired WBID and not the entire drainage area.
2. Public lands include urban and recreational areas.
3. Rangeland includes shrubland, grassland, and herbaceous land covers.

2.0 STATEMENT OF PROBLEM

Florida's 1998 Section 303(d) list identified the Ocklawaha River above Daisy Creek in the Ocklawaha River Basin as not supporting water quality standards (WQS) for total coliform bacteria. Through analysis of water quality data per Chapter 62-303, F.A.C., (Identification of Impaired Surface Waters or IWR), and the Ocklawaha River above Daisy Creek was verified as impaired for total coliform bacteria. The creek was included on the list of impaired surface waters adopted by Secretarial Order on August 26, 2002, and then submitted to EPA as part of the 2002 update to Florida 303(d) list.

During the verified period (1995-2002) for station 21FLSJWM20020001, 5 out of the 18 total coliform samples exceeded the FDEP criterion of 2400 counts per 100 milliliters (28% exceedance). With the exception of the spring season, there was moderate seasonal variability in the total coliform values, with higher averages in the summer (average of 9,667 counts/100 ml), followed by winter (average of 5,000 counts/100 ml), fall (average of 3,000 counts/100 ml), and spring (no exceedances).

3.0 DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND NUMERIC WATER QUALITY TARGET

The Ocklawaha River above Daisy Creek is classified as a Class III water, with a designated use classification for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The numeric criteria for bacterial quality used in this TMDL are expressed in terms of total coliform bacteria counts. The total coliform criteria for protection of Class III waters, as established by *State of Florida* Rule 62-302.530(7), Florida Administrative Code, states the following:

Total Coliform Bacteria:

> The most probable number (MPN) or membrane filter (MF) counts per 100 milliliters (ml) of total coliform bacteria shall not exceed a monthly average of 1,000, nor exceed 1,000 in 20 percent of the samples during any month, nor exceed 2,400 on any one day.
>
> The rule also states that, for total coliform bacteria, monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

Insufficient data were collected to base existing loads on the geometric mean criterion for total coliform bacteria. In the data assessment, the not to exceed percentage criterion and one-day maximum criterion are the most frequently violated criteria. The target for the TMDL is the one-day maximum concentration of 2,400 counts/100 ml. The TMDL represents the one-day load the waterbody can transport in a 30-day period and not violate water quality standards. It is appropriate to use the one-day maximum criteria for TMDL development as this criterion is typically violated during and/or after storm events. For coliforms, an extended dry period followed by a storm event is usually identified as the critical period when coliform levels in waterbodies exceed the water quality criteria.

4.0 ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliforms in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either “point sources” or “nonpoint sources.” Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term “nonpoint sources” was used to describe intermittent, rainfall driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, runoff from agriculture, runoff from silviculture, runoff from mining, discharges from failing septic systems, and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under EPA’s National Pollutant Discharge Elimination Program (NPDES). These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and from a wide variety of industries (see **Appendix A** for background information about the State and Federal Stormwater Programs).

To be consistent with Clean Water Act definitions, the term “point source” will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) AND stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see Section 5). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Nonpoint Sources

Typical nonpoint sources of coliform bacteria include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

The Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to characterize potential bacteria sources in the impaired watershed. Sources of impairment include leaking collection lines or leaking septic systems during low flow events, livestock having access to streams during low flow, and rainfall events when surface and stormwater runoff and infiltration/interflow dominate.

For the Ocklawaha River above Daisy Creek, there are two modes of transport for non-point source coliform bacteria loading into the stream. First, loading from failing septic systems and animals in the stream are considered direct sources to the stream, as they are independent of precipitation. The second mode involves loading resulting from coliform accumulation on land surfaces and is transported to the stream during storm events. The positioning of the water quality data values on the load duration curve provide an indication of the mode of transport occurring during periods of violations. For the Ocklawaha River above Daisy Creek, most violations are distributed on the left side of the curve (**Figure 4**), indicating violations occur during wet weather events.

4.2.1 Wildlife

Wildlife deposit coliform bacteria with their feces onto land surfaces where it can be transported during storm events to nearby streams. The bacteria load from wildlife is assumed background, as the contribution from this source is small relative to the load from urban areas. In addition, any strategy employed to control this source would probably have a negligible impact on obtaining water quality standards.

4.2.2 Agricultural Animals

Agricultural animals are the source of several types of coliform loading to streams. Agricultural activities, including runoff from pastureland and cattle in streams impact water quality. Livestock data from the 1997 Census of Agriculture for Marion County, the location of WBID 2740D, are listed in **Table 2.** The US Department of Agriculture is currently in the process of updating the agricultural census for 2002. Data from the 2002 Census will be released to the public in the Spring of 2004. As shown in **Table 2,** cattle, including beef and dairy, are the predominate livestock in this county. There are no known Confined Animal Feeding Operations (CAFOs) operating in the impaired WBID.

Table 2. Livestock Distribution by County (source: NASS, 1997)

Livestock Distribution	Marion County
Cattle	51,792
Beef	27,867
Dairy	3,819
Swine	2,509
Poultry (broilers sold)	(D)
Sheep	628
Horses	17,205

(D) – Data withheld to avoid disclosing data for individual farms.

4.2.3 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. **Table 3** summarizes the number of septic systems in Marion County and provides estimates of countywide failure rates and total daily discharge of wastewater from septic tanks.

Table 3. County Estimates of Septic Tanks (FDEP, 2001)

County	Number of Septic Tanks[1]	Percent of 1995 Population Using Septic Tanks[2]	Failure Rate per 1000[3]	Estimated Discharge (MGD)[4]
Marion	96,622	61.3	9.57	13.04

1. Total number per county is based on 1970 census figures plus the number of systems installed since 1970 through June 30, 2000. Numbers do not reflect the removal of septic systems by connection to central sewers.
2. Source: St. Johns River Water Management District, May 2000, p. 97, cited in FDEP, 2001.
3. Defined as the number of repairs divided by the number of installed systems for July 1, 1999 to June 30, 2000.
4. Based on value of 135 gallons per day per tank (FDEP, 2001).

4.2.4 Urban Development

Total coliform loading from urban areas is attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

4.3 Point Sources

There are no permitted wastewater facilities that discharge directly into the Ocklawaha River above Daisy Creek watershed. There are currently no NPDES Stormwater MS4 areas overlapping the watershed.

5.0 LOADING CAPACITY- LINKING WATER QUALITY AND POLLUTANT SOURCES

5.1 Determination of Assimilative Capacity

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. The load duration curve methodology was used to calculate the total coliform TMDL for the Ocklawaha River above Daisy Creek. Load duration curves provide a data-based method to estimate the reductions required to meet water quality standards. Load duration curves are based on cumulative frequency distribution of stream flow.

5.2 Flow Duration Curve Methodology

The first step in the development of load duration curves is to create flow duration curves. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The duration curve relates flow values measured at a monitoring station to the percent of time the flow values were equaled or exceeded. Flows are ranked from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time. Continuous flow measurements (9/1/67 to 9/30/02) taken from USGS gage 02238500, Ocklawaha River near Daisy Creek, were used to develop the flow duration curve for this TMDL, **Figure 2.** The flow and associated total coliform data in the Ocklawaha River above Daisy Creek are shown in **Figure 3.** A statistical summary of total coliform data used in the TMDL for the Ocklawaha River above Daisy Creek is shown in **Table 4**. The location of the monitoring station used to develop the TMDL is shown on **Figure 1.** Data used to compile the statistics shown in **Table 4** are included in **Appendix B.** Water quality data collected at station 21FLSJWM20020001 were used to estimate the total coliform TMDL for WBID 2740D as this represented the station with the largest amount of data and the station is located near USGS flow gage 02238500 (Ocklawaha River near Daisy).

Table 4. Summary of Total Coliform Monitoring Data

WBID	Total Number Samples	30-Day Geometric Mean	% Samples > 2,400 counts/100mL	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
2740D	18	N/A	27.8	20	16,000

Figure 2. Flow Duration Curve for Ocklawaha River Near Daisy (USGS 02238500)

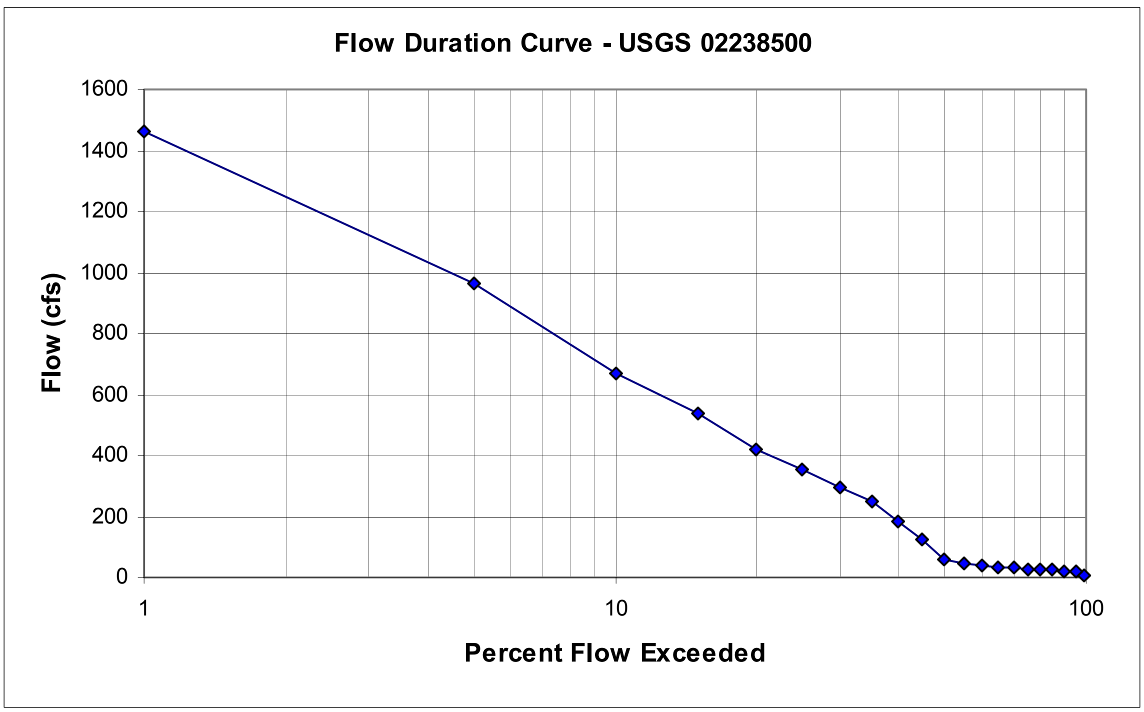
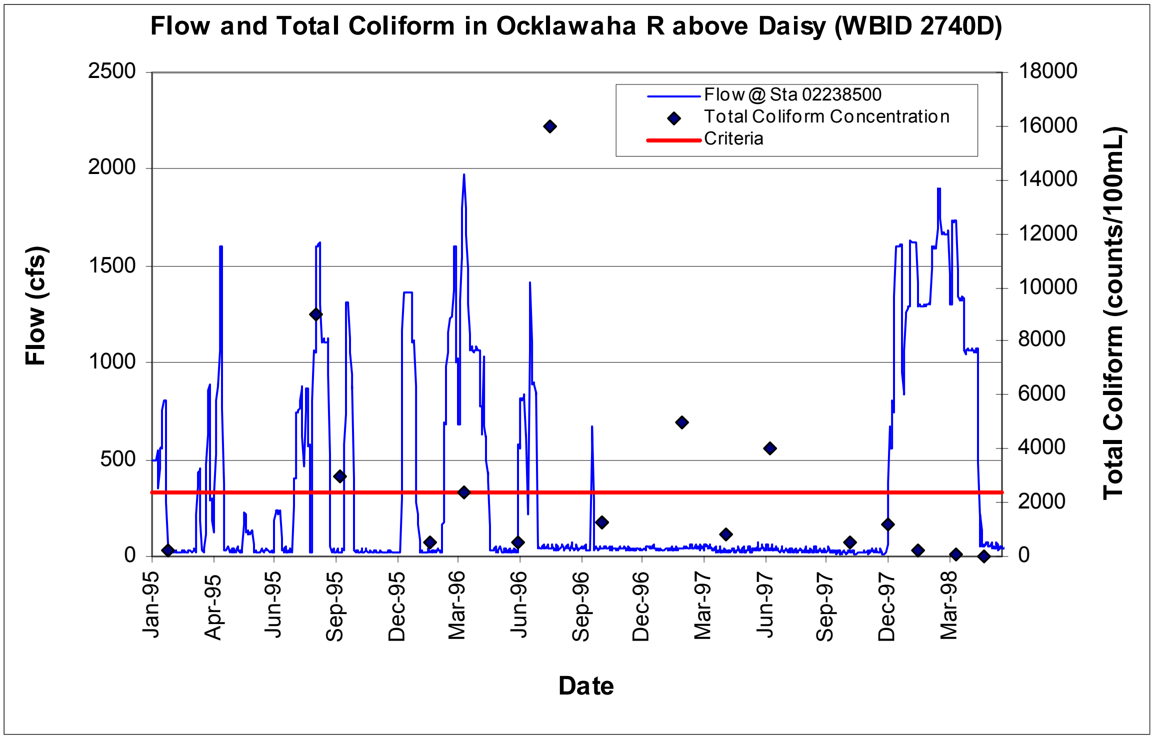


Figure 3. Flow and Total Coliform in the Ocklawaha River above Daisy Creek

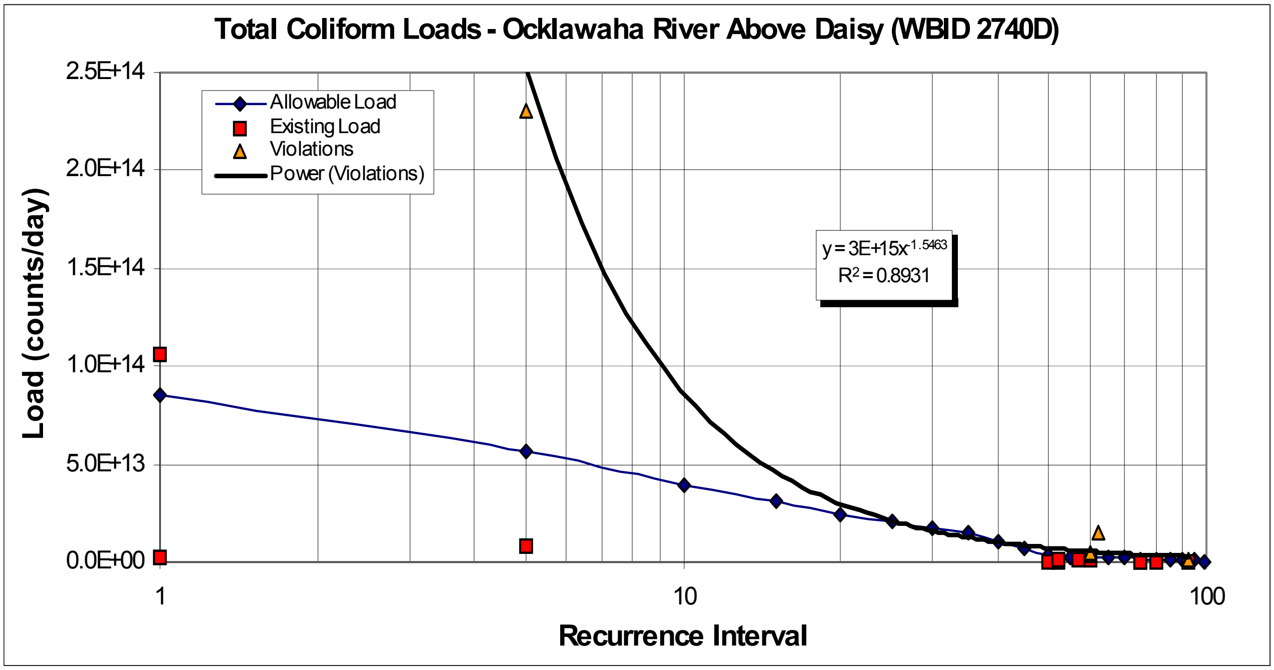


5.3 Load Duration Curve Methodology

Flow duration curves are transformed into load duration curves by multiplying the flow values along the flow duration curve by the coliform concentration and the appropriate conversion factors. On the load duration curve, allowable and existing loads are plotted against the flow recurrence interval. The allowable load is based on the water quality numeric criterion and flow values from the flow duration curve. The line drawn through the allowable load data points is called the target line.

The existing load is based on measured total coliform concentrations and an estimate of flow in the stream at the time of sampling. The positioning of the existing load on the curve is based on the recurrence interval of the estimated flow value used to calculate the existing load. Existing loads that plot above the target line indicate a violation of the water quality criterion, while loads plotting below the line represent compliance. The load duration curve for Ocklawaha River above Daisy Creek is shown in **Figure 4.**

Figure 4. Load Duration Curve for Ocklawaha River above Daisy Creek



The positioning of monitoring data on the load duration curve provides an indication of the potential sources and delivery mechanisms of the pollutant. In general, violations occurring on the right side of the curve typically occur during low flow events and are indicative of continuous pollutant sources, such as NPDES permitted discharges, leaking collection lines, or leaking septic systems. Livestock having access to streams could also be a source during low flow (it is not expected that livestock would be in the stream during high flows). Violations that occur on the left side of the curve occur during high flow events. Violations in this range are indicative of sources responding to rainfall events. As shown in **Figure 4**, water quality violations occur during both high and low flow events (i.e., flows exceeded between 5 to 70 percent of time). Potential sources in this range are in response to rainfall events when surface runoff and infiltration/interflow dominate.

The percent reduction required to achieve the numerical criterion is also provided with the TMDL, and represents the average reduction over the range of flows measured, or estimated, in the WBID. At each recurrence interval between 10 and 90 (using recurrence intervals in multiples of 5) the equation of the trend line is used to estimate the existing load. Flows exceeded less than 10 percent of the time represent abnormally high events and flows occurring greater than 90 percent of the time are extreme low flow event, both of which are not considered in the TMDL analysis. In the trend line equation, the x-variable represents the percent of time the flow is exceeded. The percent reduction required to achieve the target load is calculated at each interval. The final percent reduction is the average of these values.

A trend line is drawn through the data points representing water quality violations. In the load curve application, trend lines are used to predict the load at other flow recurrence intervals. The type of line that can be drawn through the data can have several shapes, ranging from linear (simplest form) to moving average. The type of the line chosen should result in a relatively high correlation factor, denoted by the variable R^2. The correlation factor provides an indication of how well the equation of the line represents the data. The allowable load (TMDL load) and existing load were calculated as the average value between the 10^{th} and 90^{th} duration interval. The 36.4 percent reduction (shown in Table 5) is based on the average existing load and average allowable load. Calculation of the TMDL components for the Ocklawaha River above Daisy Creek is shown in **Table 5.** A more detailed description of the method for estimating percent reduction is provided in **Appendix C**.

Table 5. Calculation of TMDL for total coliform in Ocklawaha River above Daisy

Interval	Allowable Load (counts/day)	Existing Load[1] (counts/day)	Percent Reduction
90	1.29E+12	2.85E+12	54.8
85	1.41E+12	3.12E+12	54.9
80	1.52E+12	3.42E+12	55.5
75	1.58E+12	3.78E+12	58.2
70	1.76E+12	4.21E+12	58.2
65	1.99E+12	4.72E+12	57.8
60	2.28E+12	5.34E+12	57.2
55	2.69E+12	6.11E+12	55.9
50	3.46E+12	7.08E+12	51.2
45	7.20E+12	8.33E+12	13.5
40	1.09E+13	1.00E+13	Not Needed
35	1.45E+13	1.23E+13	Not Needed
30	1.72E+13	1.56E+13	Not Needed
25	2.06E+13	2.07E+13	0.6
20	2.44E+13	2.92E+13	16.3
15	3.13E+13	4.56E+13	31.2
10	3.92E+13	8.53E+13	54.0
Average Values	**1.08E+13**	**1.57E+13**	**36.4**

1. Existing loads based on the power function trendline equation shown in Figure 4.

6.0 CRITICAL CONDITIONS

The critical condition for coliform loadings from non-point sources is an extended dry period followed by a rainfall runoff event. During the dry weather period, coliform bacteria builds up on the land surface, and is washed off by rainfall. The critical condition for point source loading occurs during periods of low stream flow when dilution is minimized. Water quality data have been collected during both time periods. Most of the violations occur during median to high flow conditions. Critical conditions are accounted for in the load curve analysis by using the complete period of flow records and water quality data available for the stream. As indicated on the load duration curve (**Figure 4**), violations occur during both high and low flows. However, most of the violations occur in the 60^{th} duration interval (conditions typical of saturated soils when a larger portion of the watershed drainage area is potentially contributing runoff).

7.0 DETERMINATION OF TMDL

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or <u>other appropriate measure</u>. The total coliform TMDL for the Ocklawaha River above Daisy Creek is expressed in terms of counts per day, and represent the maximum one-day load the stream can assimilate over a 30-day period and maintain the water quality criterion.

The TMDL is expressed in units of counts per day. The load allocation (LA) component represents the maximum one-day load that can occur in any 30-day period. There are no point sources in this segment so a waste load allocation (WLA) has not been assigned. TMDL components for WBID 2740D are provided in **Table 6.**

Table 6. TMDL Components

WBID 2740D (Ocklawaha River above Daisy Creek)	WLA (Counts/day)	LA (Counts/day)	MOS	TMDL[1] (Counts/day)	Percent Reduction[2]
Total Coliform	0	1.08E + 13	Implicit	1.08E + 13	36.4

1. TMDL represents the average allowable load between the 10th and 90th percent recurrence interval.
2. Overall reduction to achieve an instream water quality criterion of 2,400 counts/100ml.

7.1 Load Allocation (LA)

The load allocation (LA) component represents the maximum one-day load that can occur in any 30-day period and the percent reduction in loading needed to meet the total coliform criterion. As there are no point sources in this segment, the entire TMDL has been allocated to the LA The maximum total coliform one-day load for the Ocklawaha River above Daisy Creek is 1.08E + 13. Nonpoint sources will need to reduce loading by 36.4 percent to meet the TMDL.

7.2 Wasteload Allocation (WLA)

The WLA component is typically separated into a load from continuous NPDES wastewater facilities (e.g., WWTP) and the load from Municipal Separate Storm Sewer Systems (MS4s). Continuous discharge facilities have WLA units of counts/day based on permit limits and design flow, while MS4 loads are typically represented as a percent reduction. Currently, no MS4 area overlaps the Ocklawaha River above Daisy Creek watershed, and no stormwater loads were assigned to the WLA. There are no NPDES permitted facilities that discharge "coliform bacteria" to surface waters in the Ocklawaha River above Daisy Creek basin and the wasteload allocation is zero.

However, if there are future changes to the Marion County MS4 area that would result in the inclusion of the Ocklawaha River above Daisy Creek, then a WLA based on the percent reduction of the total coliform loading to the creek would need to be assigned to the MS4. Any future wastewater facility permitted to discharge coliform bacteria in the Ocklawaha River above Daisy Creek watershed shall be required to meet permit limits and must not exceed the established TMDL values. For future facilities discharging into the basin, nonpoint source loads shall be reduced such that the combined WLA and LA do not exceed the established TMDL.

MS4s typically discharge bacteria to waterbodies in response to storm events. Large and medium MS4s serving populations greater than 100,000 people have been required to obtain an NPDES storm water permit for several years under Phase I of the program. As of March 2003, small MS4s serving urbanized areas with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile are required to obtain a permit under the Phase II storm water regulations.

7.3 Margin of Safety (MOS)

There are two methods for incorporating a MOS in the Ocklawaha River above Daisy Creek TMDL analysis: (1) by implicitly incorporating the MOS using conservative model assumptions to develop allocations, or (2) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations. In this TMDL, an implicit MOS was incorporated by considering all data collected in the WBID. The percent reduction necessary to achieve water quality standards is based on the monitoring station having the largest number of samples and the highest water quality violations. Due to dilution and decay, not all stations require the same reduction to meet standards. By selecting the highest reduction, an implicit MOS is incorporated in the analysis. Additionally, the TMDL sets the water quality standard at the edge of the waterbody/point of discharge. If the allocation is met, dilution and decay could result in instream water quality samples below the numerical criteria and an implicit MOS would be realized.

8.0 IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

Following adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan for the Hatchet Creek basin. This document will be developed in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished.

The Basin Management Action Plan (B-MAP) will include:
- Appropriate allocations among the affected parties.
- A description of the load reduction activities to be undertaken.
- Timetables for project implementation and completion.
- Funding mechanisms that may be utilized.
- Any applicable signed agreements.
- Local ordinances defining actions to be taken or prohibited.
- Local water quality standards, permits, or load limitation agreements.
- Monitoring and follow-up measures.

It should be noted that TMDL development and implementation is an iterative process, and this TMDL will be re-evaluated during the BMAP development process and subsequent Watershed Management cycles. The Department acknowledges the uncertainty associated with TMDL development and allocation, particularly in estimates of nonpoint source loads and allocations for NPDES stormwater discharges, and fully expects that it may be further refined or revised over time. If any changes in the estimate of the assimilative capacity and/or allocation between point and nonpoint sources are required, the rule adopting this TMDL will be revised, thereby providing a point of entry for interested parties.

9.0 SEASONAL VARIATION

Seasonal variation was incorporated in the load curves by using the entire period of record of flow recorded at the gage. Seasonality was also addressed by using all water quality data collected near the USGS flow gage, which was collected during multiple seasons.

Appendix A

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, Florida Administrative Code (F.A.C.).

The rule requires Water Management Districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this study was conducted.

In 1987, the U.S. Congress established section 402(p) as part of the Federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five or more acres of land, and master drainage systems of local governments with a population above 100,000 [which are better known as "municipal separate storm sewer systems" (MS4s)]. However, because the master drainage systems of most local governments in Florida are interconnected, EPA has implemented Phase 1 of the MS4 permitting program on a county-wide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the DOT (Department of Transportation) throughout the 15 counties meeting the population criteria.

An important difference between the federal and the state stormwater permitting programs is that the federal program covers both new and existing discharges while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES stormwater permitting program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that can not be easily collected and treated by a central treatment facility similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The DEP recently accepted delegation from EPA for the stormwater part of the NPDES program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix B – Water Quality Data

Ocklawaha River above Daisy Creek Total Coliform TMDL Data Statistics							
WBID	Basin/Waterbody	Station ID	Date	Total Coliform	Est. Flow	Probability	Load
				(counts/100mL)	(cfs)	(%)	(counts/day)
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	5/6/1998	20	57	52	2.78E+10
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	3/25/1998	60	1740	1	2.55E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	1/24/1995	200	66	50	3.22E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	1/28/1998	220	1420	5	7.62E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	2/12/1996	500	19	92	2.32E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	6/19/1996	500	28	75	3.42E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	10/20/1997	520	26	80	3.30E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	4/22/1997	800	27	75	5.27E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	6/17/1998	800	45	57	8.79E+11
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	12/15/1997	1200	58	52	1.70E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	10/23/1996	1300	42	60	1.33E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	10/23/1996	1300	42	60	1.33E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	4/1/1996	2400	1800	1	1.05E+14
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	10/4/1995	3000	21	92	1.54E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	6/25/1997	4000	41	60	4.00E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	2/17/1997	5000	41	60	5.00E+12
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	8/28/1995	9000	1050	5	2.31E+14
2740D	Ocklawha River above Daisy Creek	21FLSJWM20020001	8/7/1996	16000	38	62	1.48E+13

2740D Data Analysis			
Station	# samples collected	# samples >2400	Percentage
21FLSJWM20020001	18	5	27.8

TMDL and existing load values represent average loads between the 10th and 90th percentile.
TMDL Load (counts/day): 1.08E+13 (based on the one-day maximum concentration < 2400 counts/100mL).
Existing Load (counts/day): 1.57E+13 (based on the power function trendline equation).
Percent Reduction: 36.4 (based on the average existing load and average allowable load).

Appendix C – Load Curve Analysis

The load duration curve is a visual display of the existing and allowable loads at each recurrence interval on the flow duration curve. The existing loads are based on the instream total coliform concentrations measured during ambient monitoring and an estimate of flow in the stream at the time of sampling. Allowable loads are based on the flow values at each recurrence interval on the flow duration curve and the applicable water quality criterion. Because insufficient data were collected to evaluate the geometric mean criterion for total coliforms, the numerical criterion of 2,400 counts per 100 ml was addressed in this TMDL. The load duration curve for WBID 2749D is shown in Figure 4.

The existing loads are separated into two groups depending on whether they violate the numerical target or not. These groups of existing loads are shown as unique symbols on the plots. The position of the loads on the curve is based on the recurrence interval of the stream flow estimated at the time of sampling. Loads are expressed in units of counts per day to reflect the instantaneous criterion. The loads represent the maximum one-day load that can occur in any 30-day period for the stream to maintain water quality standards.

Depending on the number of samples violating the target, a trendline was drawn through these points. If fewer than two samples collected on an impaired stream violated the target, a trendline was not drawn. A power function trendline was used for the Ocklawaha River above Daisy Creek as it reflected the best visual fit of the data and had the highest correlation coefficient (R^2 value). In the trendline equation, the x-variable is the recurrence interval.

The load allocation for the Ocklawaha River above Daisy Creek was calculated using the power function trendline equation. The load calculated using the trendline equation is called the existing load. At each recurrence interval, if the existing load is greater than the target load, a percent reduction is required to meet the water quality criterion. The TMDL and percent reductions were calculated as the average of all the loads and percent reductions calculated at the various recurrence intervals where a violation occurred.

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